The COLORADO Engineer

MARCH, 1968

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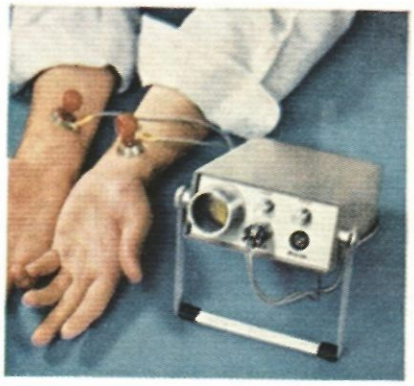

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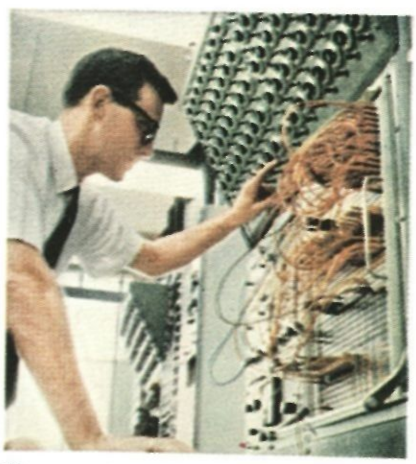

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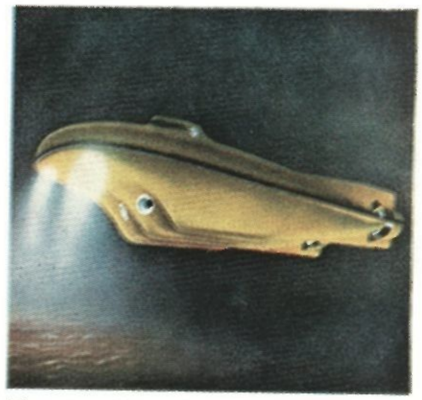

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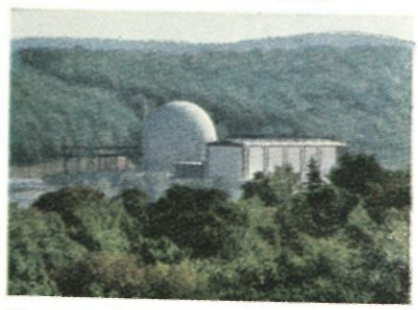

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The COLORADO *Engineer*

VOL. 64, NO. 3 MARCH, 1968

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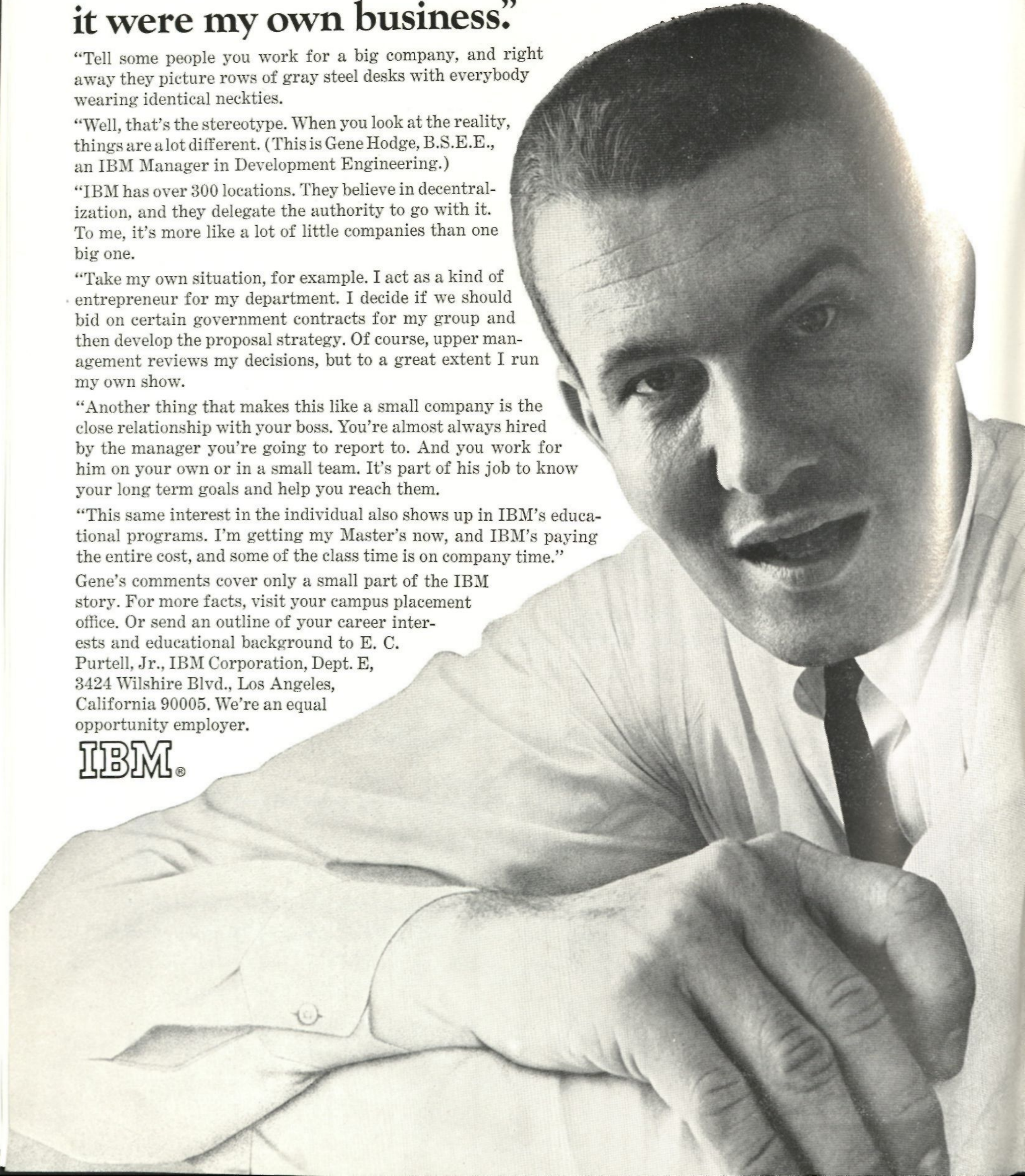


EDITORIAL:

WAR?

Recently, a topic of much debate on this campus has been the age old war between the sciences – specifically engineering – and the humanities. It is an old war, yes, but it still rages and probably always will. Why?

Well, money, financial support, is one very sensitive area. Why should engineering receive a new $9 million building and fine arts have to make do with the ancient Engineering I? Did the College of Engineering really need all $9 million – could not several less imposing buildings have been erected instead? Probably. And what about all those grants? Financial support is a funny thing. It can come from strange places for obscure things. And when it comes, the source usually wants to see output immediately. He likes to feel that he has contributed to knowledge. Since the growth of knowledge is occuring in technology, this is where he puts his money.

Another aspect of the "war" has been the accusation that engineers are not well educated in more cultural areas. And, unless the engineer makes a point of finding out on his own, he probably does not know the difference between Ravel and Monet. But, dear liberal arts majors, how much do you know about thermodynamics? Nobody can possibly know everything.

Other issues are debated in this "war". It is a situation which will never be rectified; a gap impossible to bridge. And the "war" goes on.

—Kathy O'Donoghue

DEAN'S COLUMN:

A Master's as the First Degree in Engineering

DEAN MAX S. PETERS

"The unreasonably restrictive conception that a bachelor's degree is sufficient preparation for most engineering work should not be perpetuated." *(From Final ASEE Goals of Engineering Education Report — January, 1968, p. 35)*

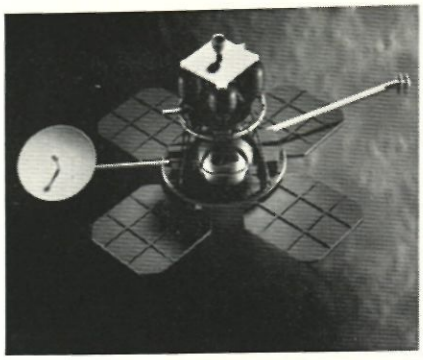
After five years of collecting and analyzing data, publishing a preliminary and an interim report, wide discussion and criticism, and the expenditure of more than $320,000 supplied by the National Science Foundation, the *Goals of Engineering Education Report* has just been released in its final form. (The 74-page *Final Goals Report* is available as the *Goals of Engineering Education—Final Report of the Goals Committee*—from the American Society for Engineering Education, 2100 Pennsylvania Avenue, N.W., Washington, D.C. 20037, at a cost of $2.00. A copy may be borrowed from the Editor's office, EC AD-1-24.) The report clearly states that its recommendations represent the views of the Goals Committee, which was composed of Dr. E. A. Walker, President of Pennsylvania State University; Dr. G. A. Hawkins, Vice-President of Purdue University; and Dr. J. M. Pettit, Dean of Engineering at Stanford University. A large amount of data and interpretation are presented in the report under the general headings of "The Engineer in the Society," "Basic Engineering Education," and "Advanced Engineering Education."

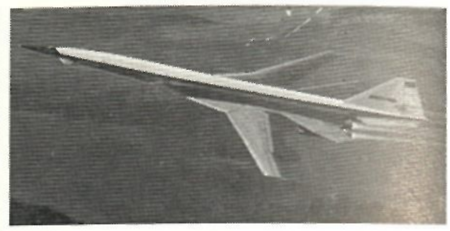
Throughout the entire report, considerable emphasis is placed on the fact that flexibility must be encouraged in engineering education to permit each university to develop its own type of program. Strong encouragement is offered for the development of different kinds of approaches to engineering education. However, despite the emphasis on flexibility, the three authors of the report give strong indication that the master's degree should become the first professional degree in engineering. They also support the desirability of developing degree programs in engineering—without specific curricular designation—and accrediting entire colleges of engineering, instead of individual curricula in engineering.

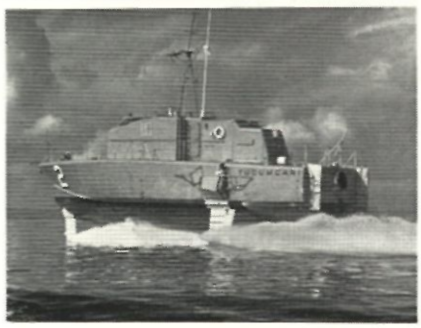
Although some persons feel strongly that certain of the goals proposed in the report are undesirable for the future of engineering education, it is, nevertheless, a fact that this report is receiving wide distribution, and part of its recommendations will undoubtedly be adopted very rapidly in some of our educational institutions. Therefore, despite the fact that many of us believe the bachelor's degree should be the first professional degree in engineering (or the basic engineering degree), it appears that more and more schools are going to move toward the master's degree as the first degree in engineering. It is, therefore, necessary for those of you who are graduating from the University with the bachelor's degree to give very serious consideration to the possibility of continuing your engineering education to at least the level of the master's degree.

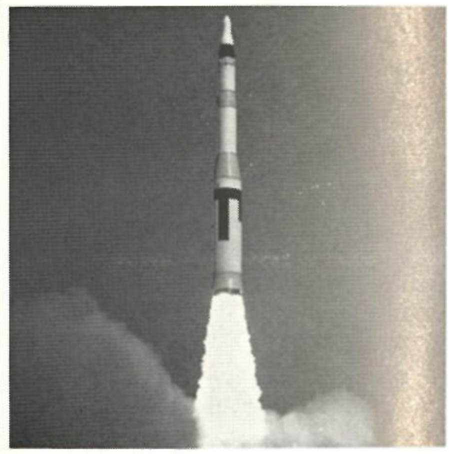
With the changes in engineering education being proposed through the *Goals Report,* combined with the normal current changes being made in our engineering programs throughout the United States and the situation on the graduate level caused by the change in the draft regulations, it appears that the next several years will see considerable turmoil and re-evaluation in engineering education. All of our schools will be making careful re-evaluations of their existing programs and plans for the future. We sincerely hope our students will be willing to help in this re-evaluation in order to make certain we develop the best possible plans for our future.

Max S. Peters
Dean









USAF SRAM. New U.S. Air Force short-range attack missile, now being designed and developed by Boeing, is a supersonic air-to-ground missile with nuclear capability. Boeing also will serve as system integration and test contractor.

NASA Apollo/Saturn V. America's moon rocket will carry three astronauts to the moon and return them to earth. Boeing builds 7.5 million-pound-thrust first stage booster, supports NASA in other phases of the program.

Boeing 747. New superjet (model shown above) is the largest airplane ever designed for commercial service. It will carry more than 350 passengers at faster speeds than today's jetliners, ushering in a new era in jet transportation.

NASA Lunar Orbiter. Designed and built by Boeing, the Lunar Orbiter was the first U.S. spacecraft to orbit the moon, to photograph earth from the moon and to photograph the far side of the moon. All five Orbiter launches resulted in successful missions.

Boeing 737. Newest and smallest Boeing jetliner, the 737 is the world's most advanced short-range jet. It will cruise at 580 mph, and operate quietly and efficiently from close-in airports of smaller communities.

USN Hydrofoil Gunboat "Tucumcari". Designed and being built by Boeing, this sea-craft will be first of its kind for U.S. Navy. Powered by water jet, it is capable of speeds in excess of 40 knots. Other features include drooped or anhedral foils, designed for high speed turns.

U.S. Supersonic Transport. Boeing has won the design competition for America's supersonic transport. The Boeing design features a variable-sweep wing, titanium structure and other new concepts and innovations.

CH-47C Chinook Helicopter. Boeing's newest U.S. Army helicopter is in flight test at Vertol Division near Philadelphia. Other Boeing/Vertol helicopters are serving with U.S. Army, Navy and Marine Corps.

USAF Minuteman II. Compact, quick-firing Minuteman missiles are stored in blast-resistant underground silos ready for launching. Boeing is weapon system integrator on Minuteman program.

Opportunity has many faces at Boeing.

Shown above are some of the challenging aerospace programs at Boeing that can provide you with a dynamic career growth environment.

You may begin your career in applied research, design, test, manufacturing, service or facilities engineering, or computer technology. You may become part of a Boeing program-in-being, or be assigned to a pioneering new project.

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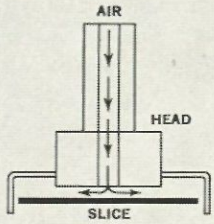
How Western Electric gets uplift from a downdraft



Picking something up by blowing a stream of air down on it may seem rather roundabout. But if you want to pick that something up without touching it, it turns out to be a most successful way.

The something in question is a paper-thin, eggshell-fragile slice of silicon destined for transistors. To touch it is likely to contaminate it, and probably to break it. Tweezers are extremely risky. Even a vacuum pickup is dangerous.

And so the engineers at Western Electric's Engineering Research Center invoked the Bernoulli principle and solved the problem. They developed a pickup device that directs a thin stream of air down onto the slice. The air flows out across the slice and since *it* is moving and the air below the slice is not, the pressure below is greater than the pressure above and the slice floats. And it doesn't touch the head because the air is, after all, blowing *down*. Wire guides keep the slice from slipping off.

So now the workers in our transistor plants can pick up silicon slices handily, without worrying about breaking or contaminating them. That our engineers reached back to a classical principle of physics to help them do it only shows the extent of the ingenuity Western Electric applies in its job of manufacturing communications equipment for the Bell System.

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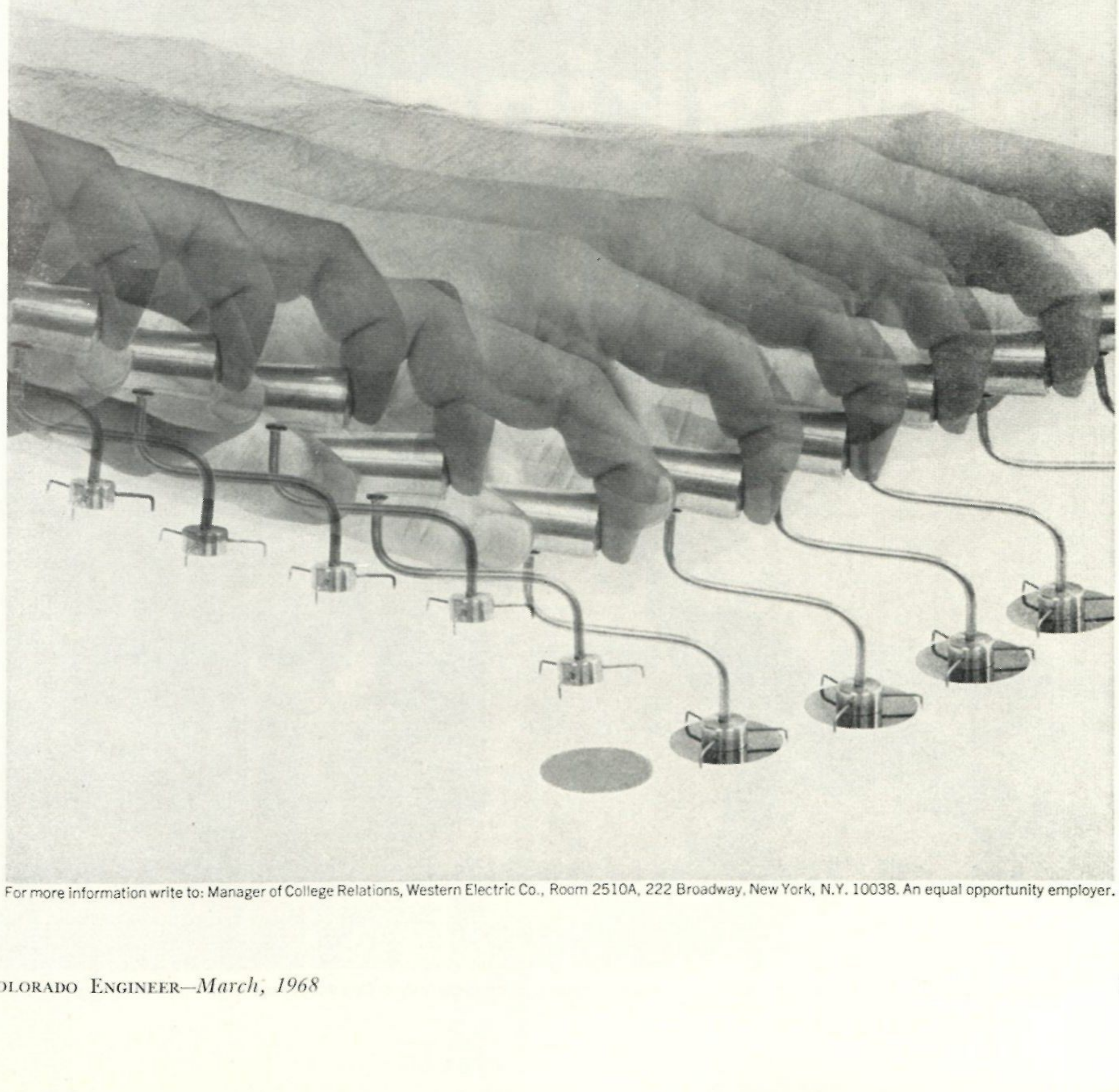


For more information write to: Manager of College Relations, Western Electric Co., Room 2510A, 222 Broadway, New York, N.Y. 10038. An equal opportunity employer.

FOR YOUR LIBRARY

The Handbook of Physics

Second Edition; Edited by E. U. Condon and Hugh Odishaw. New York: McGraw-Hill Book Company, 1967, 1729 pp., $32.50.

The *Handbook of Physics* differs from other volumes of similar title in that the user does not necessarily have to possess a Ph.D. in physics to effectively use it. Each topic is delineated in such a manner as to remind anyone who has been exposed to the basics of the particular topic, of those basics and how to apply them. The *Handbook,* First Edition—1958, was compiled under the direction of E. U. Condon, former director of the National Bureau of Standards and currently Professor of Physics at the University of Colorado, and Hugh Odishaw, former Assistant Director of the National Bureau of Standards and currently Executive Secretary of the Physical Sciences Division of the National Academy of Sciences. Over ninty contributers are listed from universities, industry and research institutions.

The *Handbook of Physics* contains nine main topic divisions, each with an average of over ten chapters and 100 subtopics. The main topic titles and some of the included chapters are:

Mathematics—algebra, ordinary and partial differential equations, tensor calculus, probability.

Mechanics of Particles and Rigid Bodies—kinematics, vibrations, orbital motion, relativity, gravitation.

Mechanics of Deformable Bodies—fluid mechanics, rheology, stress analysis, wave propogation.

Electricity and Magnetism—electromagnetic phenomenon, static fields, circuits, dielectrics, plasma physics.

Heat and Thermodynamics—theory of gases, heat transfer, chemical kinetics, superfluids, superconductivity.

Optics—electromagnetic waves, photometry, colorometry, diffraction, optics, relativity.

Atom Physics—quantum mechanics, atomic spectra, microwave spectroscopy, mass spectroscopy, fundamental constants.

The Solid State—crystallography, photoelectric effects, glass, phase transformations, magnetic resonance.

Nuclear Physics—general principles, nuclear moments, weak and strong interactions, fission, nuclear reactions, neutron physics.

The *Handbook* is well indexed, containing an over-all index before the first topic and chapter indices at the front of each individual topic section. The volumn fails to include astro-physics or geo-physics as seperate topics, but most of the necessary information and equations can be found scattered throughout the book. Since physics, by its very nature, is a field in which only specialists are to be found, the *Handbook* will undoubtedly contain portions of no use to a particular individual. It is, however, a ready reference source for the student of physics or the physicist who finds himself involved in interdisciplinary research.

—Mike Colgate

Display Systems Engineering

Edited by H. R. Luxenberg and R. L. Kuelin. New York: McGraw-Hill Book Company, January, 1968, 444 pp., $16.50.

Display Systems Engineering develops theory in the area of information science, one of the newest and most exciting disciplines. The first few chapters go into detailed discussion of various display systems and system design. The book then concentrates on such areas as photometry, visual experience, image analysis, recording media and projection systems, to name a few. Under each topic is a wealth of informative material. One area, not mentioned previously which is discussed is laser holography, a topic of intense interest to solid-state advocates.

It must be pointed out that though the material within *Display Systems Engineering* is very informative, it is mainly directed toward the researcher or graduate student. It could be used by the more advanced senior undergraduate but the author states that the book, a part of the McGraw-Hill Inter-University Electronics Series, is designed for the advanced engineer or scientist.

Comprehension of this text's contents will require an extensive background in solid-state physics and computer programming. *Display Systems Engineering* just does not compare with undergraduate texts in terms of readability.

—Herman Husbands

An Introduction to Queueing Theory and Telephone Traffic

Petr Beckmann, Boulder, Colorado: The Golem Press, 1968, 144 pp., $4.25 – Hardbound, $3.00 – Softbound.

Although its title implies the application of queueing theory to one specific area, *An Introduction to*

Queueing Theory and Telephone Traffic is a very basic introduction to the theory of waiting lines which merely uses telephone traffic for illustrative examples. Developed from class notes for a short course in Telephone Traffic Theory which Professor Beckmann taught at the Regional Communications Engineering School during the summers of 1956 and 1957, the book develops the theory of queueing, assuming only an elementary background in calculus and probability theory, and is aimed toward students of management science and engineering.

Introduction to Queueing Theory covers single channel and multiple-channel systems, Poisson, exponential and Erlang distributions, delay and efficiency. Practical application rather than rigorous theory is emphasized. Over sixty problems are presented; however, no answer section is included. Since this is a beginning text, answers would be of immense help.

Also presented are tables of Erlang loss and delay probabilities for loads from 0 to 15 and 1 to 25 channels. Programs in Fortran and Basic languages are given for those who wish to expand the limits of the tables.

For someone interested in basic queueing theory, *Introduction to Queueing Theory and Telephone Traffic* would provide a good introduction. It would be useless to the OR expert because of its lack of rigor.

—*Kathy O'Donaghue*

The Engineer's Handbook: Illustrated

Arthur Liebers. New York: Key Publishing Company, 1968, 319 pp. $5.95.

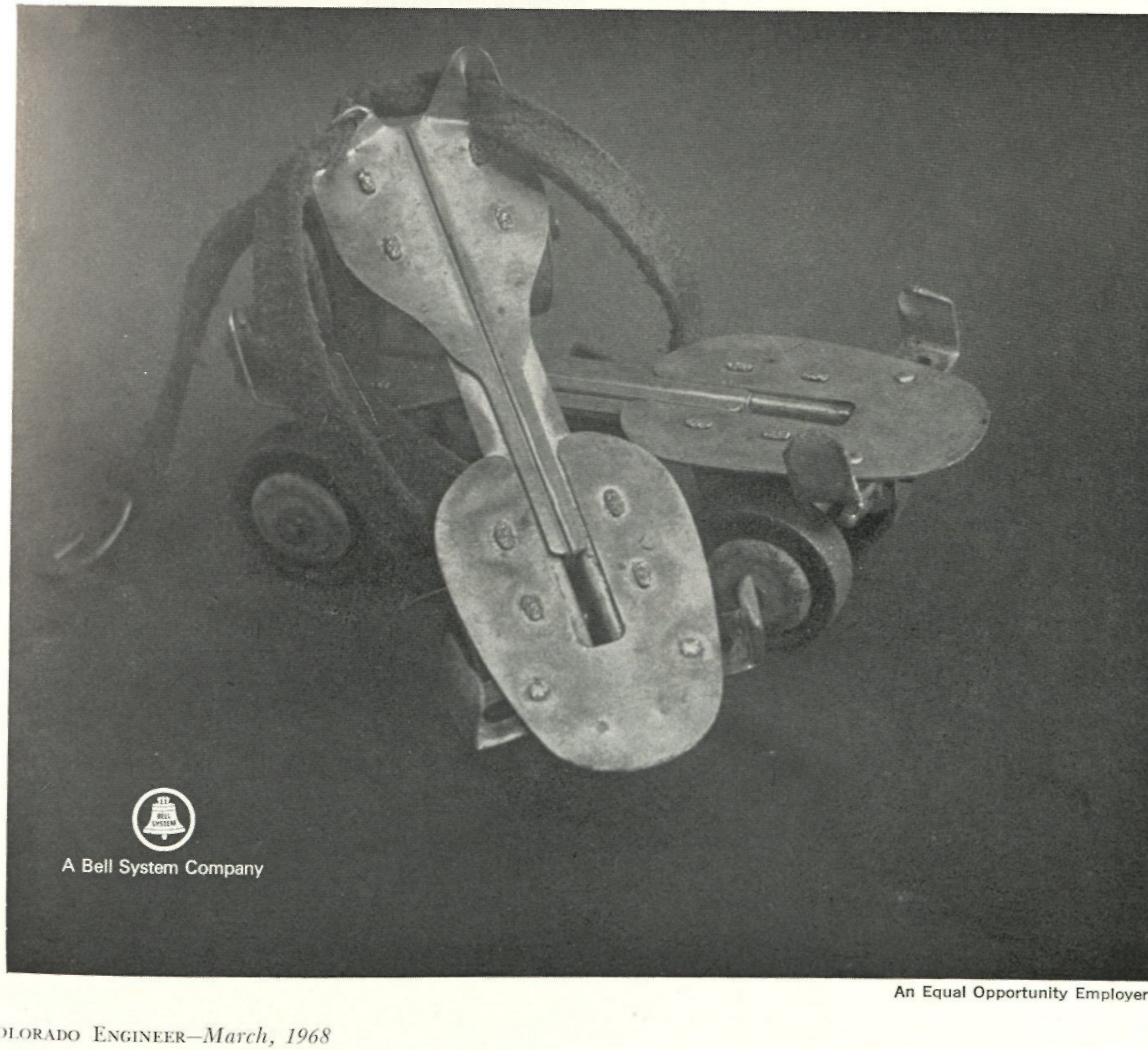
The Engineer's Handbook Illustrated is an elementary reference book for the serious craftsman. It attempts to adequately answer engineering problems in construction, electrical systems, power ratios and sources. The accurate illustrations allow rapid interpretation and easy understanding for the person with a non-technical background.

The book could aid the engineer in fields not related to his field. It has a small reference section on construction requirements; the book would be more effective if it had a reference section attached to each of its topic section.

The Engineer's Handbook Illustrated is well organized with basic definitions and symbol descriptions in every section. Tables and graphs are effectively used when ever possible. The Air-Conditioning and Refrigeration section is very adequate. Diagrams showing available hardware sizes with descriptions of materials used are incorporated with diagrams showing their uses. The section on knots might be found useful.

This book would be useful to the engineer only in fields not related to his own and could be use to the non-technical person interested in basic engineering problems.

—*Randy Lorance*


A Bell System Company

ENGINEERING UNIONS: THEIR RISE AND SUBSEQUENT DECLINE

KATHY O'DONOGHUE

The engineering union first appeared on a noticable scale in the years immediately following World War II. There were in existence some unions involving engineers before this time which had grown out of company unions, but not until 1945 was the engineering union recognized on a national scale.

Why They Organized

There were three major reasons for the growth of unions in the engineering profession. During the period immediately following World War II, job insecurity plagued industry in the United States. Engineers and production workers alike were affected. Also, the engineers felt that the wage differential between engineering salaries and production wages was inadequate and they attributed this to the production unions working for the benefit of the workers. Thirdly, the National Labor Relations Board, established in 1935 by the Wagner Act, made several decisions which forced the engineers into trade unions against their wishes. Other reasons have also been cited which suggest that faulty management caused the need for organization of the engineers. The engineers lacked adequate identification with management and were dissatisfied with the inadequacy of communication channels, the lack of individual professional recognition and the merit rating system.

Richard E. Walton, who has done an extensive study of engineering unions, suggests that the reasons often cited are symptomatic of a more fundamental dissatisfaction. The professional's control over his job had been reduced. The growth of the companies increased the separation between the engineers and decision-making management; specialization and division of labor caused the growth in the formality of the engineering organization; and the individual engineer became less critical to the successful operation of the company, thus losing his effective bargaining power. (10,370-71)

Trade Unions Want Organized Engineers

It has also been suggested that it was not the dissatisfaction of the engineers with their working conditions but rather the interest in the engineer demonstrated by the industrial trade unions which caused the establishment of engineering unions. Some of the traditional trade unions tried to convince the engineers that they were not professional persons but shared common interests with the factory worker.

(Continued on page 23)

(Continued from page 21)

The National Labor Relations Act

In 1935, Congress passed the National Labor Relations Act (now commonly called the Wagner Act) which dealt with the rights of employees and the interference of employers with these rights. The National Labor Relations Board was established to assure the achievement of the objectives of the Act. Although the Wagner Act had no specific objectives toward the unionization of white-collar workers, they found themselves extremely involved in its application because, unlike agricultural laborers, railworkers and government employees, professionals were not specifically excluded from the stipulations of the Wagner Act. The National Labor Relations Board had sometimes placed professional workers into bargaining units with non-professional employees and the establishment of white-collar unions was the best protection from this. The majority of the engineering unions were established between 1945 and 1947.

At first, the establishment of engineering unions was encouraged by some of the professional societies, who feared that inclusion of engineers in traditional labor unions would lower the status of the engineering profession. In 1947, the professional societies of civil engineering (ASCE), mechanically engineering (ASME), electrical engineering (AIEE), chemical engineering (AIChE) and mining and metallurgical engineering (AIMME) and the National Society of Professional Engineers (NSPE) jointly published the *Manuel on Collective Bargaining for Professional Employees.* (10,20)

The Labor-Management Relations Act

The Labor-Management Relations Act (the Taft-Hartley Act) was passed in 1947 as an ammendment of the Wagner Act. This Act dealt in part with the professional employee, defining a professional employee and exempting him from the Wagner Act. It established a separate tribunal for dealing with the professional employee, excluded professional employees from heterogeneous units, allowed professionals to waive their right to bargain collectively and required the National Labor Relations Board to allow professional employees to decide, by vote, which bargaining unit would represent them, if indeed they wished one. It totally eliminated one of the major reasons for the establishment of engineering unions in the first place. However, organized engineers continued to support unionism.

National Organization of Engineering Unions

Most engineering unions were company organizations. They remained separate from, not only industrial unions, but also the national union movement (the AFL-CIO) and even similar unions in other companies. The isolation of the individual unions hindered their effectiveness. In 1952, seventeen separate unions met in Chicago and established the Engineers and Scientists of America (ESA), a federation of engineering unions with no individual members but only member units.

The purpose of ESA was to promote the professional, social and economic welfare of the engineer and scientist by gathering national information on salaries, working conditions, living costs, bargaining procedures, legislation and other pertinent information; aiding the establishment of professional employee organizations for the purpose of collective bargaining and assisting in negotiations; acting as spokesman for the engineering unions to government; and encouraging the improvement of the quality of engineering and science education. (10,27)

Peak of National Association Activity

ESA activity reached its peak in 1956. At this time, less than ten percent of the engineering population was organized into unions (50,000 engineers) and this was the most active period of engineering union activity. (22,100) National organization did not achieve what the organizers of ESA had hoped it would; the federation was full of discontent. Some of the groups felt that ESA should not limit its membership to engineers, as it did, but include technicians and draftsmen. In 1958, several of the member groups broke away and formed the Engineers and Scientists Guild, which included not only engineering unions but also heterogeneous groups which, in some cases, counted as thirty percent of their membership, technicians, draftsmen and other persons directly related to engineering. (23,32)

Although they couldn't agree among themselves on how their ob-

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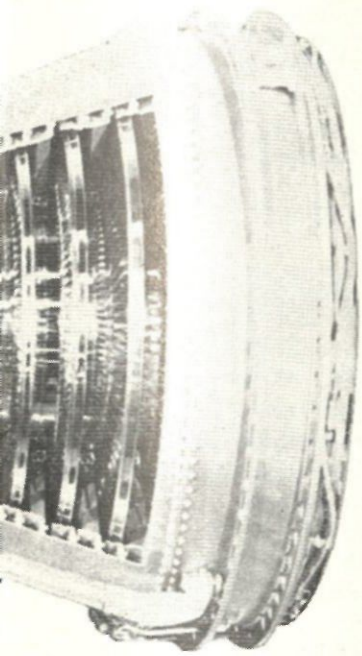

MAJOR ENGINEERING ASSOCIATIONS—1956

Company	Union Name	Total Represented	Number Members	Unit Representation Prof.	Unit Representation Non-Prof.
Aircraft-Aerospace Industry:					
Boeing	Seattle Professional Engineering Employees Association ESA	7,950	2,643	7,400	500
Douglas	Southern California Professional Engineering Association	6,728	3,990	5,280	1,448
General Dynamics	Engineers and Architects Association ESA	6,700	3,050	4,210	2,490
Lockheed	Engineers and Scientists Guild, Lockheed Section	2,320	1,044	2,097	293
Scientific Instruments Industry:					
ITT Labs	Local 400, Professional, Technical and Salaried Division, IUE, AFL-CIO	836	——	556	300
Minneapolis-Honeywell	Minneapolis Federation of Honeywell Engineers	1,040	——	——	——
Sperry Gyroscope Corp.	Engineers Association, ESG	3,400	1,800	2,670	730
Petroleum Industry:					
Shell Dev. Co.	Association of Industrial Science	390	330	390	——
Standard Oil Co. (Indiana)	Research and Engineering Professional Employees Association	550	——	550	——
Electrical and Electronic Industries:					
GE	Association of Engineers and Engineering Assistants	245	141	178	67
RCA	Association of Professional Engineering Personnel, ESA	1,800	1,450	1,800	——
Western Electric	Council of Western Electric Professional Employees, Nat'l, ESA	6,000	——	——	——
Westinghouse	Federation of Westinghouse Independent Salaried Unions	1,700	1,500	1,445	255

Figure 1 — Major Engineering Associations.

(Continued from page 23)

jectives should be achieved, both the ESA and the ESG firmly believed in unionism for engineers. Their feelings were well expressed by ESG President Hall in 1959:

> As employees, we can advance ourselves economically and give rightful dignity to our occupational pursuits and status by bargaining collectively with our employers and by representing the engineering and scientific community before the general public and governmental agencies. (18,94)

Both groups felt that engineers in industry were becoming subject to too many rules and regulations in which they had no say and which were detrimental to their professional and economic status. They believed that through unionism, they could protect themselves and achieve the economic and professional recognition that they deserved.

Both ESA and ESG were dissatisfied with the the change in the attitudes of NSPE and the founder societies toward engineering unionism. They accused them of being dominated by management to such a degree that when the interests of the engineering employee conflicted with those of management, the employee was forgotten. (16,35)

National Organization Attempt Fails

Near the end of the fifties, ESA disbanded. Its downfall in 1959 is attributed to financial difficulties, the looseness of its internal structure and the improvement of the engineers' status over the decade. Engineers and scientists were very sensitive to the general unfavorable public opinion of labor unions and felt that association with them was detrimental to the status of the professions. ESG had the same fate shortly afterward.

There was a movement in the AFL-CIO to include the engineering unions within their ranks. The International Union of Electrical, Radio and Machine Workers (IUE, AFL-CIO) and the American Federation of Technical Engineers, AFL-CIO (which was composed mainly of technicians) conducted many campaigns to get engineering unions to affiliate with them, and were successful in a few cases. They felt that the tendency of engineers to move into management hurt the engineering profession and blamed the NSPE for poisoning the minds of young engineers against unionism while they were still in school.

In 1963, several engineering associations on the west coast banded together into the Council of Engineers and Scientists—West. This organization included mainly the California aerospace industry unions such as those at Lockheed, Douglas and General Dynamics, but also had as members the Southern California Gas Company and the Los Angeles Department of Water and Power units of organized engineers. The members were mostly electrical, mechanical and civil engineers and CESO—W claimed to represent 20,000 engineers and scientists.

There are still active engineering unions in existence, but on the whole, they proved ineffective and thus, most of the national organizations were also ineffective.

The Local Engineering Union

In 1956, at the peak of engineering union activity, there were active associations in many major companies (see Figure I). The aircraft-areospace industry, the scientific instruments industry, the petroleum industry and the electrical and electronics industry each had their share of unions in both major and minor companies. There were also unionized engineers in utilities (such as Los Angeles), public works (the Tennessee Valley Authority) and in other smaller industries, but there was a noticeable lack of union organization in the machinery and chemical and allied products industries--they were virtually unaffected by unionism.

The approach of the engineering union was unique. It was basically the approach of an engineer to a problem. Firmly schooled in reason and logic, the engineer very strongly believed that he had reasonable needs and had only to educate management regarding these needs. Because management was composed of reasonable men (indeed, some were engineers), it would seek to alleviate the problems. The first goal of the engineering union was to convince management that the engineers meant no harm to management by unionizing. The approach was commendable, but on the whole, it proved to be quite ineffective. Unions are founded on the premise of collective bargaining; the basic purpose of collective bargaining is to cause an employer to do something that he would not do otherwise through the use of force.

Collective Bargaining Approach Unworkable

The engineer proved to be very incompetent in collective bargaining. He made the error of believing that a collective bargaining relationship could exist in a cordial and dignified manner and that it could solve problems without any resort to the exercizing of power. Engineers did not engage in pre-negotiation talks with management, which are necessary to establish the feasibility of the union demands within the framework of the company. They thought them to be unethical. When the economic facts of life conflicted with the logic, the engineer stuck to his logic. But collective bargaining cannot be approached with the scientific method.

Failures of the Associations

The first agreements included many clauses referring to the shop procedures which had nothing to do with the engineers. They also clarified patent payments, professional society dues, some rating procedures and salary provisions, mostly in the form of insurance plans, retirement plans and the like.

Engineering union leaders became disillusioned with the reasonable approach and began to adopt a tougher line. There were six major strikes during the fifties involving engineers. They were considered successful by the participants, but whether they actually accomplished very much is debatable. The worst characteristics of union influence appeared in the 1958 strike of the Association of Professional Engineering Personnel at RCA. The engineering pickets snake-danced about and threw eggs. Seven engineers were arrested for disorderly conduct and assult and battery on a police officer. The union members conducted twenty-four hour telephone campaigns to the "scabs" (those engineers who would not join the union or participate in the strike). And, after the strike, essential technical information was withheld from non-union employees--they were given the silent treatment. (14,26)

The unions did not, on the whole, like the idea of striking and suggested several alternatives such as withholding engineering reports and refusing to perform any duties directly relating to production. However, none were considered professional and they were never tried.

In 1957, perhaps in retaliation, management in one major industrial firm reduced the work force in some unionized engineering departments. This was the first major lay-off of engineering workers.

Successes of the Associations

Some unions did have favorable results, mainly in companies indifferent to engineers. The union forced management to adopt attitudes and policies more consistent with the professional status of the engineer. In many instances, companies have introduced salary increases and other benefits independent of union activity. In one case, when a unionized company instituted an educational assistance program for the engineers, the union complained because it had not been negotiated! (4,225)

How did management react to the unionization of engineers? It was very concerned because the attitude of the engineer toward his job was vital to the effective operation of the engineering phase of the company. When the union entered the engineering picture, the organized engineers became more concerned with how they did their work—the physical conditions of their job—rather than with what they were doing. The managers felt that the engineer should be more concerned with the client than with the engineering rating system. The engineer is a professional who seeks to make a contribution to society in a creative way and concern with such petty issues as casual overtime and the setting of minimum standards for engineering work hindered this contribution.

As one executive pointed out: The engineer works close to the core of management decisions. He has the responsibility for the technical development of processes and products and the success of the company depends upon the ability of the engineer to meet the customer's demands. Engineering is subjective rather than objective and it requires much more than an established routine. (10,339-40)

Unions declined among engineers when their economic environment improved and they realized that they could not reconcile their professional ideals with the union premises.

Unionism and Professionalism

Professionalism believes that the interests of society and the client are of paramount importance. Unionism believes that the economic interests of the members are far more important than those of the client. What could possibly make the two compatible?

The Research and Professional Employees Association of one unidentified oil company stated:

> . . . the principles of a professional union are not opposed to the principles of professionalism . . . the union provides a two-way channel of communication between the professional employees and the company . . . and professional unions don't have to stifle individual initiative. In fact, by working toward an improved professional climate, they encourage initiative. (9,192)

The professional and technical unions felt that unionism was the only mean of providing the protection which would enable the engineer to place his conscience and public trust above his loyalty to his employer, which marks a true professional.

The Engineers Joint Council interpreted the matter in the very opposite light. In 1956, EJC stated:

> To the engineer who feels that life provides an opportunity for constructive contribution to society, collective bargaining with its attendant potentiality for creating conflicting obligations is not acceptable. (4,224)

The engineers who opposed the unionism of engineering felt that it was increasingly difficult to honor the ethics of the engineering profession under unionism. The engineer wants individual, not collective treatment, with rewards for his personal contributions rather than negative reactions from his coworkers who accuse him of trying to impress management and get ahead of his fellow engineers when he practices his profession in the true sense of its meaning in a unionized engineering department. The engineer has a strong sense of idealism and professional responsibility. To him, the rewards of creative challenge and the sense of accomplishment at accepting the challenge mean as much, if not more, than the tangible rewards.

The rise and fall of unionism in engineering has shown that the interests of engineers are best served by cooperation and respect between the engineers and management rather than by hostility and conflict.

BIBLIOGRAPHY

BOOKS:

1. Alger, Philip L., N. A. Christensen and Sterling P. Olmsted, *Ethical Problems in Engineering*. New York: John Wiley and Sons, Inc., 1965.
2. Blood, Jerome W., *Optimum Use of Engineering Talent*. New York: American Management Association, 1961.
3. Davenport, William H. and Daniel Rosenthal, *Engineering: Its Role and Function in Human Society*. New York: Pergamon Press, 1967.
4. Kemper, John Dustin, *The Engineer and His Profession*. New York: Holt, Rinehart and Winston, Inc., 1967.
5. Mantell, Murray I., *Ethics and Professionalism in Engineering*. New York: The Macmillan Company, 1964.
6. Orth, Charles D., Joseph C. Bailey and Francis W. Wolek, *Administering Research and Development: The Behavior of Scientists and Engineers in Organizations*. Homewood, Illinois: Richard D. Irwin, Inc. and The Dorsey Press, 1964.
7. Smith, Ralph J., *Engineering as a Career*. New York: McGraw-Hill Book Company, Inc., 1962.
8. Sturmthal, Adolf, *White-Collar Trade Unions*. Urbana, Illinois: University of Illinois Press, 1966.
9. Walters, J. E., *Research Management: Principles and Practice*. Washington, D.C.,: Spartan Books, 1965.
10. Walton, Richard E., *The Impact of the Professional Engineering Union*. Boston: Harvard University, 1961.

PERIODICALS:

11. Booth, A. K., "Let's Take Another Look at the Causes for Professional Bargaining Groups," *Journal of Engineering Education*. 45:4 (December 1964) 358-360.
12. Chandler, E. L., "Union and the Engineer," *Mechanical Engineering*. 71:10 (October 1949) 821-830.
13. Deutsch, Z. C., "Collective Bargaining: Does It Conflict With Engineering Ethics?" *Chemical and Metallurgical Engineering*. 51:8 (August 1944) 96-102.
14. "The Engineering Union—Dinosaur in the Space Age," *American Engineer*. 31:7 (July 1961) 23-26, 57.
15. "Engineering Union Fights for Life," *Fortune*. (May 1960) 246-51.
16. "Engineering Unionism Faces a Time for Decision," *Engineering News-Record*. 162:16 (April 23, 1959) 30-31, 33-35.
17. "Engineering Unionism: New Twist," *Engineering News-Record*. 164:14 (April 7, 1960) 103-4.
18. "Engineering Unions Form Federation," *Engineering News-Record*. 160:9 (February 27, 1958) 94-5.
19. "Engineering Unions Grow," *Steel*. 139:7 (August 13, 1956) 53-4.
20. "Engineers Reject AFL-CIO Affiliation," *Engineering News-Record*. 168:23 (June 7, 1962) 90-1.
21. "Engineers Say No to Union," *Chemical and Engineering News*. 38:22 (May 30, 1960) 27.
22. "Engineers Split on Union Issue," *Engineering News-Record*. 162:12 (March 26, 1959) 100.
23. "ESA Folding Up," *Chemical and Engineering News*. 38:51 (December 19, 1960) 32.
24. Evans, T. H., "Let's Look at the Causes for Professional Collective Bargaining Groups," *Journal of Engineering Education*. 44:7 (March 1954) 389-391.
25. Forshay, R. L., "Collective Bargaining for Professional Employees," *Mechanical Engineering*. 68:11 (November, 1946) 968-70, 975.
26. McKetta, J. J., "What Price Professionalism?" *Petroleum Refiner*. 38:2 (February 1959) 193-5, 197-8.
27. Miller, G. W., "Unionization of Engineers—A Re-Examination," *Journal of Engineering Education*. 45:10 (June 1955) 775-9.
28. Morse, G., "Engineering Ethics—From the Viewpoint of Industry," *Journal of Engineering Education*. 45:3 (November 1964) 214-19.
29. Mortimer, Forrest S., Gust Warner and W. Conrad Fernelius, "Should Professional Employees Be Unionized?" *Chemical and Engineering News*. 32:45 (November 8, 1954) 4456-61.
30. Rude, H. Neil, "White Collar Unions and the Law," *Personnel Journal*. 43:17 (February 1964) 88-96.
31. Shoch, Clarence T., "The Professional Union—A Contradiction," *Journal of Engineering Education*. 45:4 (December 1964) 345-57.
32. "Unions for Engineers Are Showing New Vitality," *Engineering News-Record*. 170:15 (April 11, 1963) 82-3.
33. Wilson, Joseph G. et. al., "How Professional Is Engineering," *Mechanical Engineering*. 86:6 (June 1964) 18-24.
34. Yarnall, D. R., "Unionism and Collective Bargaining," *Mechanical Engineering*. 69:1 (January 1947) 80-1.


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TAU BETA PI ESSAY:

THE PARADOX OF STRUGGLE

ALEMAYEHU ASRES

Every living creature is characterized by a natural instinct to struggle for its survival and humans are no exception to this general behavior. Inherent drives for self betterment, wealth, power and glory are human traits that have stood the test of time. As much as twentieth century man struggles to cope with his ever-changing and ever-expanding needs by changing his environments to meet his needs, primitive man might have used all his resources and ingenuity to convert a sharp edged stone into a useful cutting tool. Thus, in all levels, struggle for better things and better ways has been, and still is, man's way of life. However, it is pathetic that, over the years, man seems to have developed a tendency to make struggle an end by itself rather than a means to an end.

In the stone age, when man had not quite learned to use his brain as efficiently as he used his muscles, struggle was in its simplest form—a natural motivation to keep body and soul together. This required endless and violent fights between man and beast, man and nature, and man and man. It was a bloody era and only the fittest could survive; but there was something beautiful about such an existence—it was uncomplicated. Instinct was the golden rule to reaction and there was very little emotional reaction to speak of: eat when hungry, sleep when tired, strike when annoyed. . . Those good old days! What peace of mind primitive man must have enjoyed. Unfortunately (or is it fortunately?), man developed his mental proficiency as time went by and spoiled the beauty of simplicity through a slow process known as civilization.

The nineteenth and twentieth centuries were marked by the greatest breakthrough in man's ability to control his environment. Human achievements in science and technology have been tremendous. Unfortunately, it is doubtful if the same can be said about man's understanding of himself. Although considerable knowledge has been accumulated about the functioning of the human body and mind, this knowledge has apparently not contributed markedly towards explaining the subtilties of human inter-relationships. Thus, modern man exists in a state of emotional turmoil, instability and chaos. Primitive man might have had to indulge in physical violence to ensure his survival. Is it quite obvious then that modern man exists under any better conditions? Struggle, violence and conflict are still part of man's life, although there may be more emotional rather than physical violence in the modern version of struggle; but whether such a state of existence is superior in any sense may be a debatable issue. What man has gained from all the years of his struggle to better himself is then difficult to understand in terms of human contentment.

In the so called underdeveloped nations, humanity still exists on subsistence economy. Many die of plain starvation, malnutrition or the lack of adequate medical care. Consequently, the struggle is mainly a desperate attempt to acquire the basic needs such as food, clothing, shelter, and facilities to keep the body as fit as possible. In contrast, man inhabiting the more advanced nations has already crossed these initial barriers and, to a naive observer, this might look like sufficient reason for contentment. Oddly enough, this is not the case. As a matter of fact, it is generally agreed that the struggle is more vigorous than ever before, and that humanity still suffers—only from a different ailment. This is indeed absurd. If man cannot be more content with more leisure time when he is materially better off, one begins to wonder if all along man's civilization process, unnecessarily too much importance had been attached to the value of material wealth beyond what is essential for the perpetuation of life, or if some of the social institutions created by man himself have been responsible for producing conditions that have militated against human contentment and peace of mind.

Never-ending Ladder

The present human condition may be better illustrated with a simple analogy. It is like a man running to catch a rabbit. He desperately wants to catch it and yet, when he does, he finds that he is not as pleased as he thought he would be now that the anticipation and excitement is over. Moreover, he discovers that he is not the only one who succeeded in catching a rabbit—so he wants to catch a lion next time. But the same thing happens if he catches a lion without getting killed. This then is the "paradox." Man seems to be at a loss. Achievement on one level of the social strata just brings a person to the bottom of the ladder of the next level. The steps never end, and the climb becomes more and more exhasting and frustrating as he gets higher. It is difficult for many to face reality and stop when the climb gets too steep for them. Therefore, they struggle, forever, and become victims of eventual frustration.

Looking For Something Which Is Not There

The hows and whys of the confusion in modern living are obviously matters of great complexity and controversy. Yet, some possible explanations may be postulated, although they are by no means justifications for the existing conditions. One of the major contributing factors may be the fact that modern man tends to be a social being and his life becomes meaningful only in relation to other humans. Each individual measures his achievements relative to those enjoyed by others and, consequently, looks up to other human beings for approval and praise. Such a condition, in turn, produces a hypocritical society where each individual is expected to stand up to certain standards without due regard to his personal capacity or individuality. Clearly all men are not equally gifted intellectually or physically. Only a handful of people can and do manage to enjoy the glory of excellence in each field of specialization. This then leaves the mass craving for recognitions of one kind or another. Such a human condition is sometimes desirable because it may be conducive to creativity, but it is also a major cause for misery and frustration for several reasons. First, many are forced to strive for achievement in certain fields, not because they have the desirable aptitudes or because they are motivated by profound interests, but because those fields seem to entail better material returns. Such a situation is responsible for misplaced talents and, consequently, forgone achievements—hence frustration. Secondly, not all people are capable of estimating their capacity, clearly defining their objectives, and setting their goals within reasonable limits. Thus, in an attempt to meet unrealistic expectations, they end up in a wild goose chase—looking for something which is not there. Worse yet, there has been an unfortunate tendency to resort to material accumulation for a measure of individual achievements. This has resulted in a disastrous race because the standards keep on getting higher and higher, and the average person simply does not have the stamina to keep up with the ever increasing demands.

See The World The Way It Is

It would perhaps be quite naive to propose a simple remedy for a human situation of such complexity. However, it would also be cowardly and irresponsible to stand by totally uncommitted and unconcerned. Realizing that a bad idea may be more thought provoking than no idea at all, it is appropriate to point out that there is an urgent need to mobilize human efforts to reorganize traditional thinking and traditional values to save humanity from self-destruction. Ambition and success are meaningless unless they lead to individual happiness, and material success is no guarantee for contentment. This is evidenced by the fact that laborers struggle for an extra dollar or two; the millionaires struggle, even harder, for an extra million or two, and they are not any happier. This is substantiated by the greater rate of heart attacks and ulcers among "successful" businessmen. Admittedly, life would not be too exciting if there is nothing to strive for because there would be nothing to entertain the ego on the individual level and no means of coping with the crowded world of tomorrow on the global level. On the other hand, there is also little point in suffocating oneself under the pressure of outrageous modern demands if such a condition, in the long run, renders humanity incapable of recognizing, much less appreciating, the rewards of its struggles. An acceptable compromise must be reached by the individual himself. This statement may, unjustly, be misinterpreted as a pessimistic proposal for apathy. It is not! It is a plea to face reality and see the world as it really is. With due regard to the inevitability and importance and even necessity of having dynamic societies, the incentives and motivations that bring about changes and innovations are badly in need of a more realistic and objective interpretation and understanding, or a re-evaluation to give meaning to human struggle.

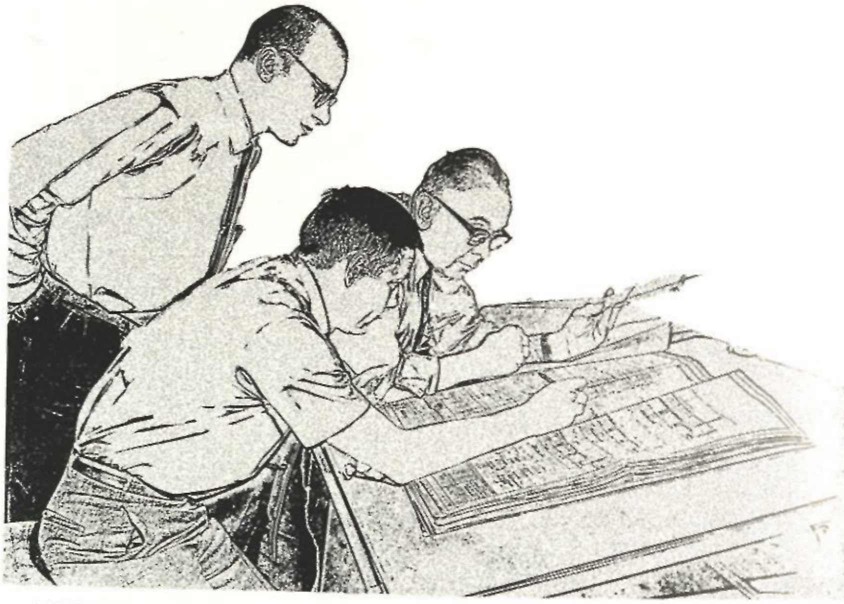
Craving For Recognition

It ought to be quite obvious by now that technological achievements and the consequent affluence have not necessarily promoted human contentment on the individual, national or international level. This is not to say that the results of centuries of human efforts have been fruitless, but to point out that humanity is suffering from a mounting physical and mental strain unnecessarily. Modern man needs to fit into his world in such a way as to make struggle a bridge to his contentment and not his sole purpose in life. The physical facilities on which so much energy is expanded ought to be valuable only as accessories to satisfaction, otherwise the world may be filled with people who run and run without even knowing where they go. Moreover, the endless struggle and the lack of feelings of adequacy and self-respect may be conducive to further material greed, a further widening of the gap between the haves and have-nots, a more desperate craving for recognition and power, and a growing oversight of the fact that man stands above all. This in turn may torment mankind to such an extent as to trigger another major war. With the potential of present day instruments of destruction, such an event can easily unwind the clock back to the stone age. Humanity would then learn the hard way, and man of today would have to assume the moral responsibility for the possible destruction of man of tomorrow.

The Engineer's Struggle

In conclusion, it may be interesting to mention a disturbing fact about engineers. There is a popular belief to the effect that engineers are uninformed about world affairs, uninterested in the humanities, incapable of appreciating the arts—in short, dull, uninterested and uninteresting. These are indeed unpleasant assertions and unfortunately, there may be some truth in them. One may plead that the engineer is too deeply involved in his profession to have time for anything else. This may be fine if he enjoys devoting all his time to his gadgets, but it is not clear if he does so of his own free will or if he has been conditioned to believe that life is work and work is life. Would he prefer life with a little more variety if he had a choice; and if so, why does he not have a choice? How much is the engineer contributing to the paradox of struggle? Has he forgotten that the purpose of his struggle is to make life easier for mankind, and that he is a member of this unpredictable species? Does he struggle to live or live to struggle?

Resolution: Struggle hard to achieve, *but* also contribute a happy man to the world. Doing both at the same time should constitute "success."



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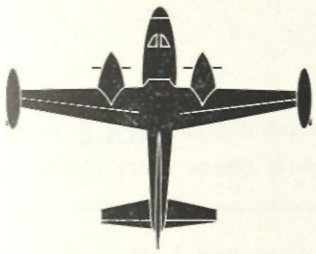

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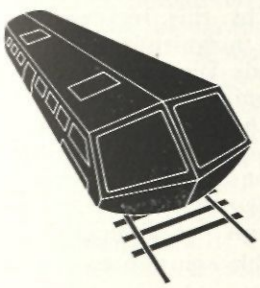

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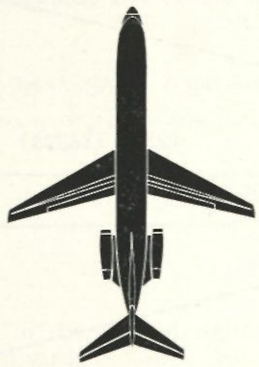

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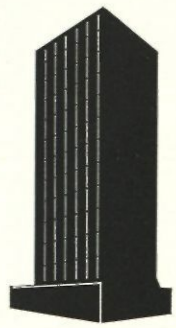

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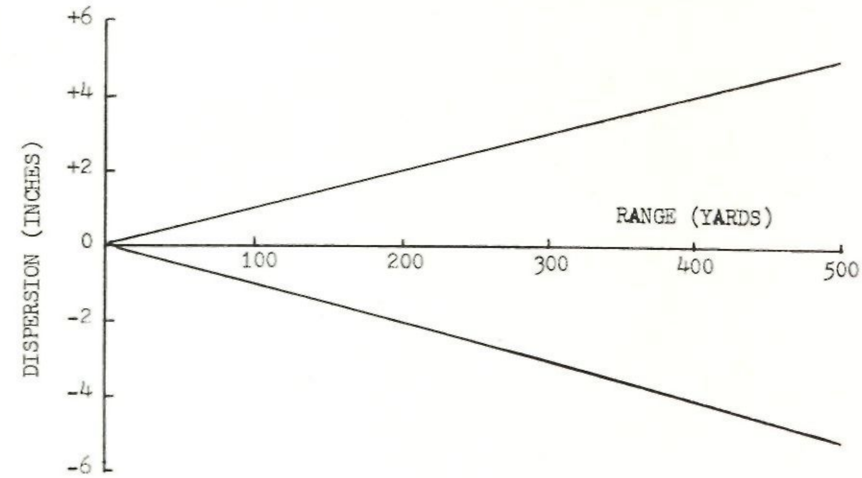
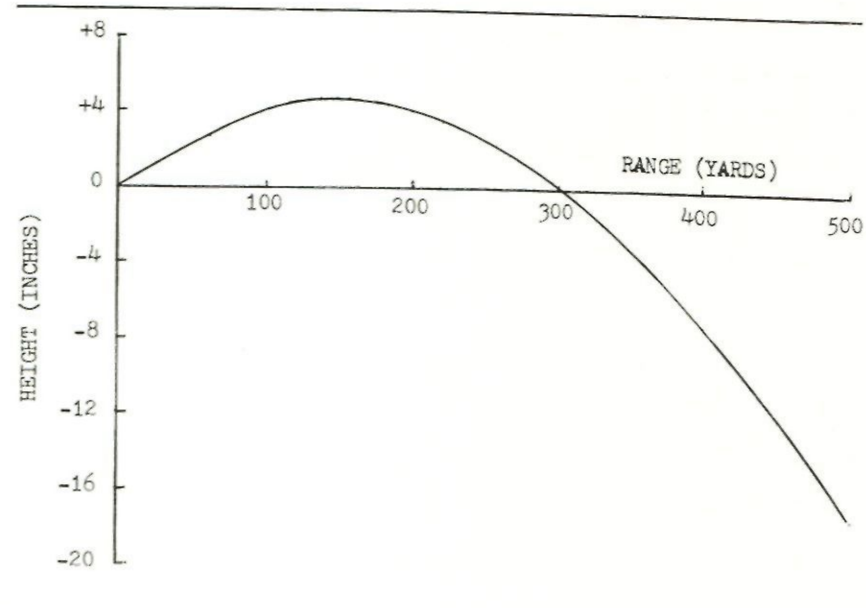
THE 300 WINCHESTER MAGNUM:

INCREASING SHOOTING ACCURACY

BRUCE ECKHARDT





The magnum rifle has considerably extended the effective target range for a hunter. However, the inherent errors in range estimation and trajectory correction are also amplified by this increased distance. Of what magnitude are the errors involved? What can the hunter do to minimize the effect of these errors and use the increased range potential to his advantage? This discussion will demonstrate the answer to the first of these questions, and by means of a minor scope modification offer a possible solution to the second.

It should be realized in the beginning that even the higher explosive killing power of the magnum at short-to-moderate ranges will not exist at ranges extended to five and six hundred yards. It is for this reason that an understanding of one's own gun's ballistic characteristics is essential since hitting within the animals vital target area becomes even more important. Determining the dispersion area of a particular gun and its relationship to the animals vital target area at some specific range will be considered first.

Figure 1 *(above left)* — Linear error magnification with increased range.

Figure 2 *(left)* — Trajectory of bullet for 300 Winchester Magnum zeroed for 300 yards.

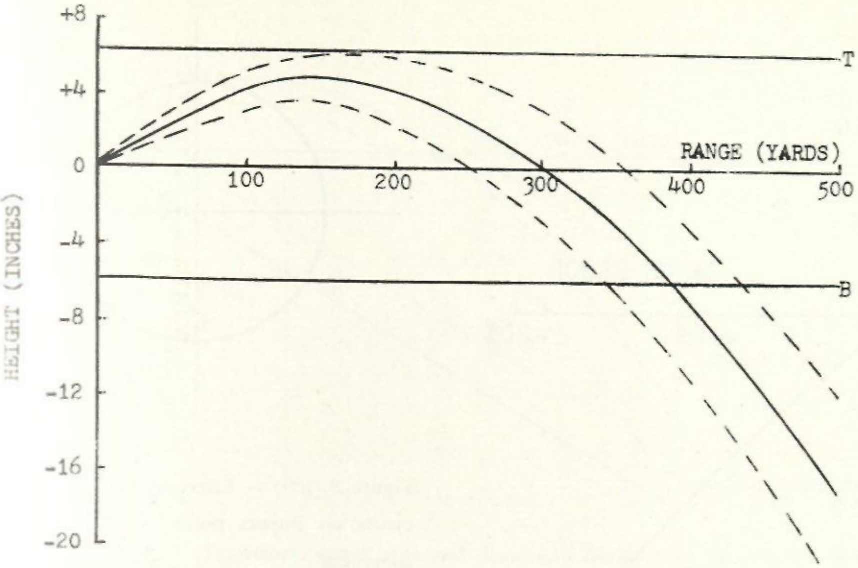


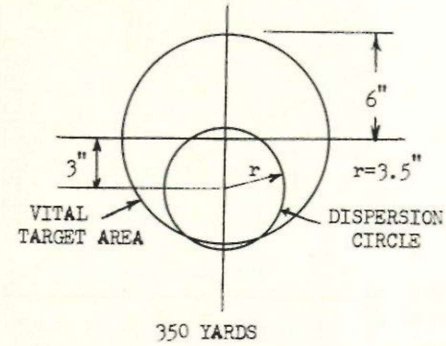
Figure 3 *(above)* — Trajectory plus dispersion assuming two-inch group at 100 yards.

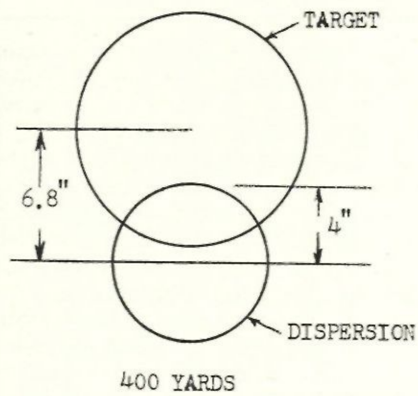
Figure 4 *(above right)* — Vital target area and related dispersion area at 350 yards.

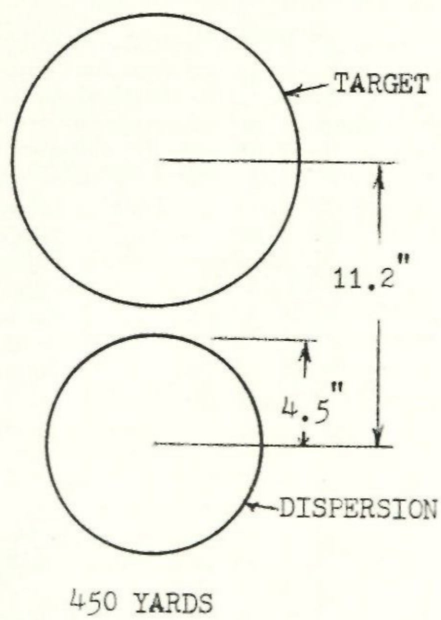
Figure 5 *(right)* — Vital target area and related dispersion area at 400 yards.

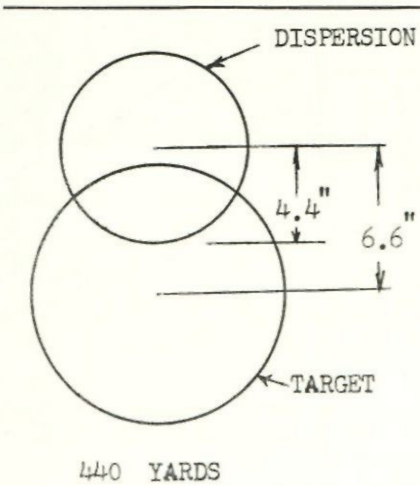
Figure 6 *(right)* — Vital target area and related dispersion area at 450 yards.

Figure 7 *(lower right)* — Dispersion and vital target area (–12% range error) at 500 yards.









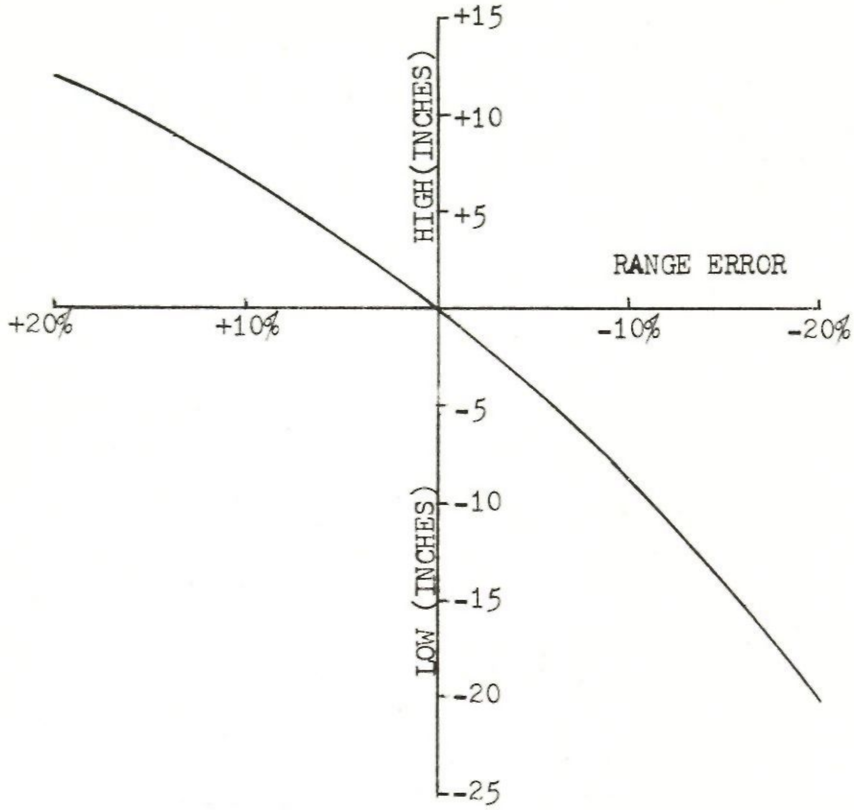
In the ideal case, a gun mounted ridigidly in a vice clamp, the dispersion of several shots will still only group in a circle of about one-inch diameter at one hundred yards distance. This implies that even a skilled marksman will be limited, on the average, to this accuracy. The additional variance of human error, although important in calculating total dispersion, will not be discussed.

If it is assumed that a bullet travels a straight line trajectory once it is clear of the gun's muzzle, it can be seen (Figure 1) that a random deflection of one-tenth of one degree at the muzzle will expand to a two-inch group at one hundred yards, a four-inch group at two hundred yards, and so on. At five hundred yards, the grouping pattern has expanded to a circle with a diameter of ten inches.

To be realistic, however, it is necessary to account for the effects of gravity and the aerodynamic drag which begin to effect the bullet the instant it leaves the gun's muzzle. As long as the bullet remains in the air it will be accelerated towards the ground. The initial angle with respect to the ground and the initial velocity of the bullet will determine the length of the flight path. This trajectory therefore depends upon the type gun and the type bullet used. Figure 2 shows the trajectory of a 300 Winchester Magnum bullet fired with an initial velocity of 3400 ft./sec. and zeroed at three hundred yards. (It would not be practical to zero a rifle for five hundred yards since the normal shooting range is between two to three hundred yards.) The graph shows the position of the bullet with respect to the line of sight. At five hundred yards the bullet has dropped about seventeen inches below the reference.

Assuming a two-inch dispersion at one hundred yards, Figure 3 shows the trajectory plus dispersion at various ranges. A twelve inch diameter area (TB), the approximate vital area of a deer, has been super-imposed on the graph to show the bullet's position with respect to the target when the line of sight is the center of the target area.

Figure 4 is the dispersion area superimposed on the target area at a range of three hundred and fifty yards. The two areas correspond nearly 100% which implies that a chance for a hit within the vital region is also nearly 100%. If this comparison is extended to four hundred and five hundred yards (Figures 5 & 6) the chance of hitting the vital area has been reduced to about 30% and 60% respectively.



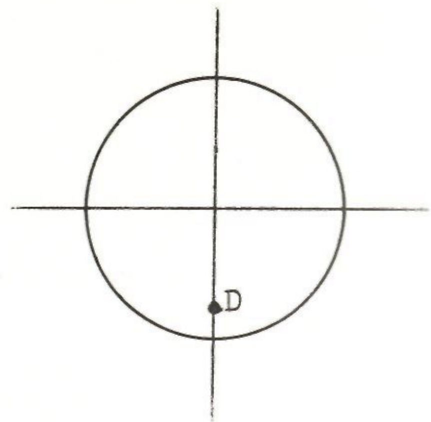


Figure 8 *(left)* — Effect of range estimation errors on impact point — 300 Winchester Magnum.

Figure 9 *(above)* — Placement of dot (D) on recticle.

Some adjustment must therefore be made to bring the two areas back into correspondence at five hundred yards. This can be done, of course, by estimating the range as five hundred yards, and, with prior knowledge of the ballistic characteristics, aim seventeen inches above the target center. This would be approximately eight inches above the deer's shoulder and at best would only be a good guess. In addition, if the actual range of the target is four hundred and forty yards (a –12% error, but still a very good estimate) the chance for a hit within the vital area has been reduced considerably. At this point the bullet has dropped about ten inches (Figure 3) and assuming no dispersion, enters one inch above the vital area. The dispersion area at four hundred and forty yards is 8.8 inches in diameter and when super-imposed on the target (Figure 7) shows an approximate 36% chance of a vital hit. A –12% range error at five hundred yards has reduced the vital hit possibility by 64%. The effect of range estimation errors on impact point, for the 300 Winchester Magnum, is shown in Figure 8.

What can be done to improve the odds? A small dot can be placed on the recticle of the scope (Figure 9) [The proposed scope modification and the data were supplied by Pharis E. Williams.] which, when sighting at a target with a twenty-three inch-diameter, at a range of five hundred yards, will appear at the bottom edge of the target area. Figure 10 shows the trajectory plot with the addition of a solid line (D) which becomes the new line of sight when the dot on the recticle is used in place of the normal crossed hairs. The two dashed lines (TB), as in Figure 3, enclose the vital target area, but we now set three inches above the new line of sight. This assumes the dot is placed at the brisket (lowest point of a deer's body) which is approximately three inches below the vital target area. With the addition of the dispersion area (Figure 11), it can be seen that the two areas again correspond, but this time about 80% at five hundred yards (Figure 12) and nearly 100% between the ranges of 425 to 475 yards. Therefore, with no guess at all, the chance of a vital hit has in-

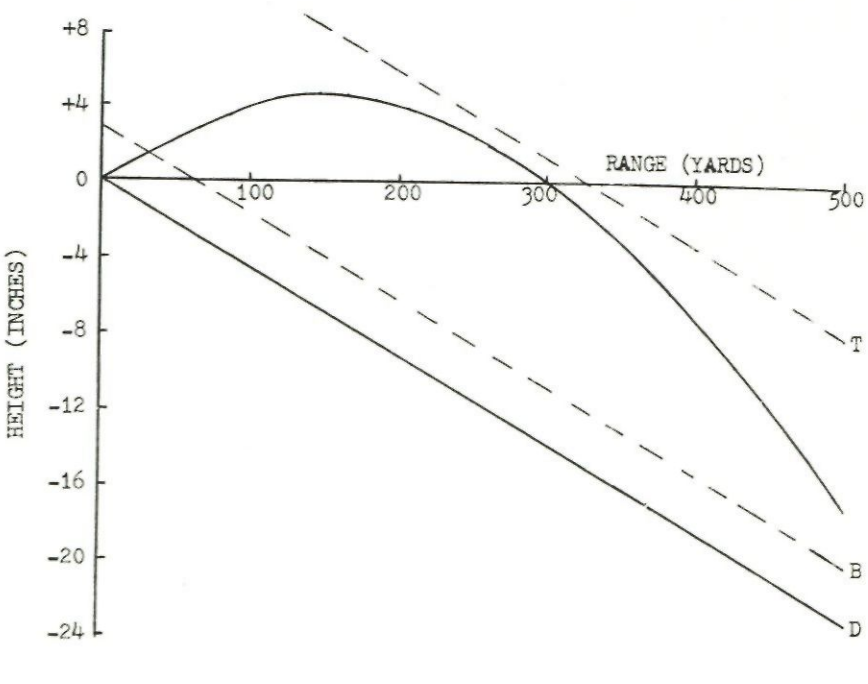


Figure 10 *(left)* — Trajectory and vital target area for new line of sight (D).

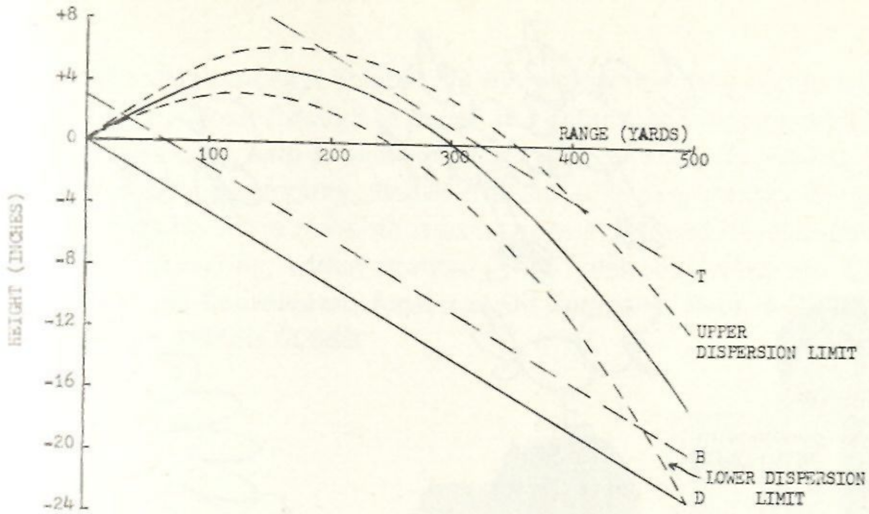


Figure 11 *(above)* — Trajectory, target area and dispersion limits using the recticle dot as the line of sight.

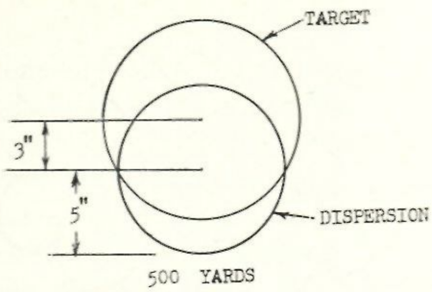


Figure 12 *(above)* — Vital target area and dispersion area at 500 yards for the new line of sight.

creased a minimum of 44% at 500 yards.

The only question remaining is knowing when to use the crossed hairs of the scope and when to use the newly-positioned dot as the line of sight. For this particular arrangement, the crossover is about three hundred and sixty yards. At this range the chance of hitting within the vital area is a minimum, about 75%, and equal for both lines of sight. It would be reasonable then to use the crossed hairs below three hundred yards and aim at the center of the vital area and to use the positioned dot above three hundred yards and aim at the brisket. And there is no real concern about any range estimation error around the three hundred and sixty yard crossover point since the beauty of this system is the 25% maximum loss in vital target area over the entire five hundred yard range.

It is worth remembering that the slight scope modification that has been proposed can be applied to any gun. It is, however, important to understand that the modification will vary with each and every gun and with each ammunition used since the individual trajectories will vary considerably. Once the particular ballistic characteristic is determined, it is relatively easy to apply this technique and make the additional distance capability of the magnum worthwhile.

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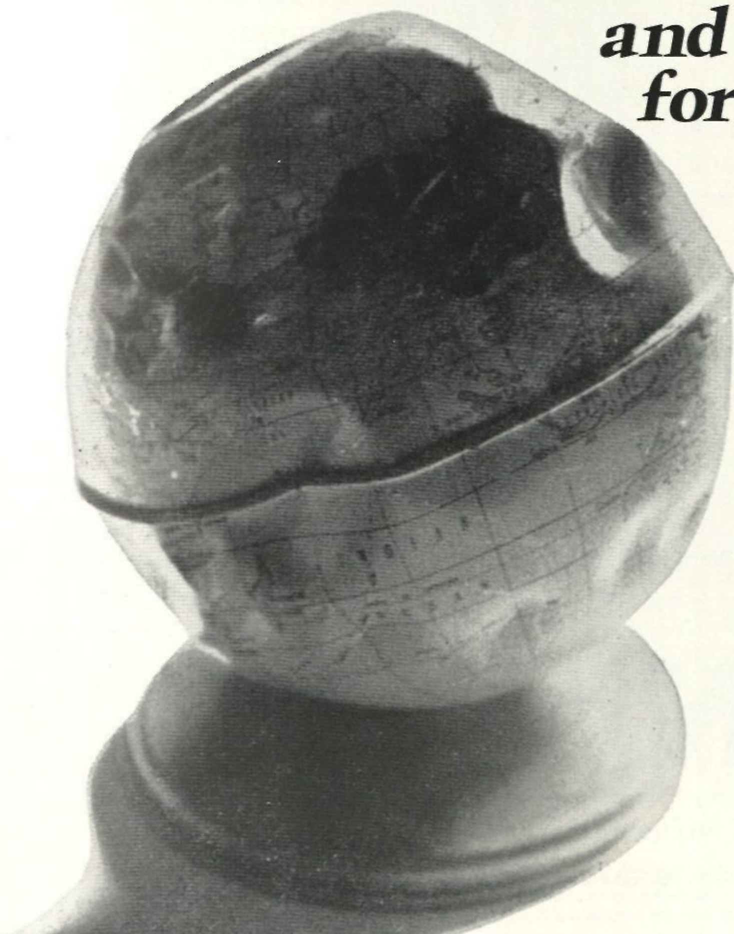

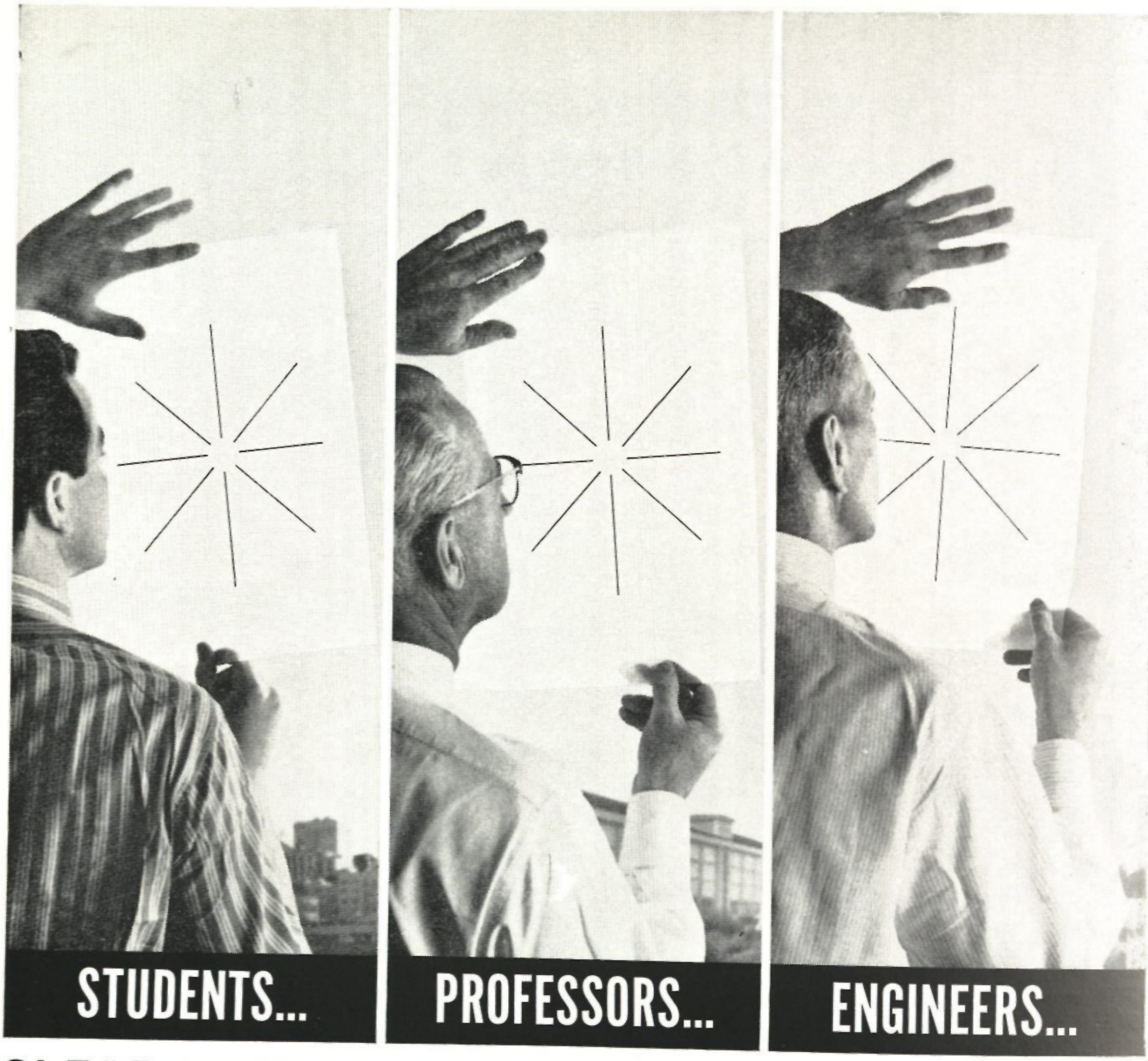

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PUZZLES:

The Too Many Suspects and Not Enough Evidence Case

MIKE COLGATE

The following is from the diary of Mydih Wattsit, friend, counsellor and flunky to Sherlock Fitzgerald: world-renowned detective, notary public, and opium fiend.

February 5: We have arrived at the scene of the murder, but to my admittedly inexperienced eye, the mystery seems insolvable. I will list the facts, to perhaps gain a clearer perspective of the situation.

Suspects: Dr. Hastle: 5'8" tall, 140 lbs., blue eyes, no hair, 65 years old; arrived here at the convention ten days ago. Lord Beckwith: 6'5" tall, 145 lbs., brown eyes, blonde hair, 55 years old; arrived thirteen days ago. Peter Beckwith (the Lord's son): 6'5" tall, 145 lbs., brown eyes, blonde hair, 25 years old; arrived thirteen days ago with his father. Mr. Harold Wilcox: 5'7" tall, 235 lbs., blue eyes, gray hair, 67 years old; arrived two weeks ago. William "Wee Willy" Safford: 4'1" tall, 63 lbs., gray eyes, no hair, 44 years old; arrived fifteen days ago.

The Scene: a windowless, square room, with an eight-foot ceiling and twenty-foot walls. The ceiling is bare, save for a small hole near the door through which the remains of what once was a three-foot service bell rope hangs. The walls are covered from floor to ceiling with bookshelves, filled with books and documents. The single desk, opposite the door, is cluttered with, among other things, a blotter, reading spectacles, law books, and one marble bookend, all blood-splattered. The floor contains two overturned chairs and one bloody marble bookend. Also, one overturned small foldin& ladder (used for reaching the top shelves), and one volume of Hayden's CRIMINAL LAW, both directly below the book's proper spot on the top shelf, next to the desk.

The Victim: Sir Clarence Cook, deceased, 6'4" tall, 200 lbs., closed eyes, bloody hair, 37 years old; arrived two weeks ago. He lies between the overturned chairs in the center of the room, his skull crushed and nearly two feet of bell rope wrapped tightly around his neck.

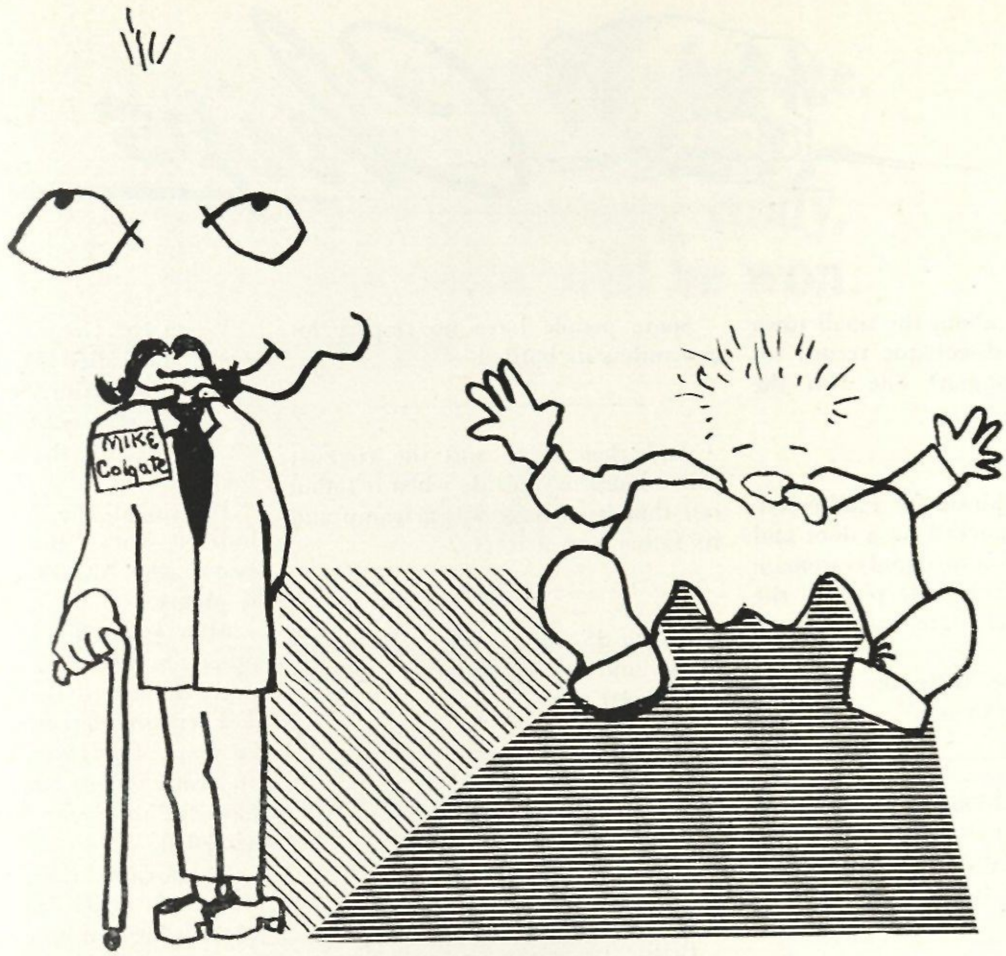
Witnesses: none.

Sherlock has questioned the house staff and found that Sir Clarence was involved in a violent argument with one of the suspects, but no one seems to remember exactly when the argument occured or who the other participant was.

There are two gardners employed on the grounds. They never both work on the same day and some days neither works. On questiong the two, we have learned that since the argument, there have been seven days on which the first gardner didn't work and seven days on which the second gardner didn't work. Altogether, however, there has been a gardner working on 10 separate days since the argument.

The house butler has disclosed that yesterday, the day of the murder, he was in the servants' quarters at 10:30 a.m. He heard the service bell ring loudly, once, and went to the lounge, just nevt to the murder room, since one ring signifies service wanted in the lounge. He found the lounge to be empty and was just about to leave the room when the two bell signal for the study (the murder room) rang, immediately followed by the sound of the opening and closing of a door and hurried footsteps. The second ringing must have come from the study, as the study and lounge have the only bell ropes in the house. Seconds later, upon opening the study door, the butler found the murder scene as I have described it.

If the suspect with whom the victim argued is the guilty person, who is the murderer?



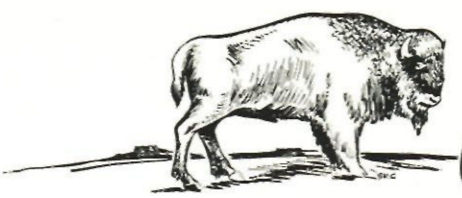
ANSWERS TO LAST MONTH'S PUZZLES FROM THE PLANET ZAN

1. There are more than enough clues given to determine the names of each native. The easiest method is to take first into consideration the facts that Finster observed: that the tallest native wore the hat and that the shortest wasn't drunk and didn't wear shoes. From those observations, we can see that the shortest native must have been the flat-foot and, from the rhyme, was named Herman. The first line of the rhyme say's that Zug was *not* the tallest native. Neither could Zug have been the next tallest, because the tallest did not wear shoes. Zug therefore was the drunk and next-to-shortest native. Only Ug and Lug remain, and since the rhyme says Ug was taller than Lug, the native with the hat was named Ug.

2. The question Finster asked the tall native had to be so contrived as to force a liar to give the same answer as a truth-teller. Since the answers were limited to "yes" and "no," the easiest method would be to ask a question *about* the crucial question, thus forcing a liar to lie about a lie. One possible question: "What would you reply if I asked you, 'Is the right hand road the road to the capitol?'?" A truth-teller would reply truthfully, while a liar would be forced to lie about his answer to the internal question, the resulting answer being the same as the truth-teller's.

3. First, we must calculate the distance from Zan to the moon. At the instant that the moon was half full, we can form a right triangle, with the moon at the 90° vertex and Zan and the sun at the other two. Since we know Zan's period of revolution is 15 x 24 or 360 hours, we can determine the angle of the triangle at the sun is 8 minutes, 35 seconds. Consulting a trig table or converting to radians and approximating, we find that the moon is 250,000 miles away from Zan. This implies that the capitol was 250 miles away—too far to walk in time. The spaceship was only 12½ hours away, however, and the trip to the moon only 11 hours 24 minutes, making a total of 23 hours 54 minutes: six minutes to spare. Finster naturally flew to the moon instead of the capitol because he was already overdue at the Space Marine base and would have had to pay his parking fine if he entered the capitol.

THE MURDER OF SIR CLARENCE COOK WILL BE SOLVED IN THE MAY ISSUE.



Chips

Did you hear about the small town girl who set a discoteque record for twisting the longest? She was the torque of the town.

Dressed as a pirate for Halloween, the small boy knocked on a door and was greeted by a matronly woman. "Aren't you a cute little pirate," she said. "But where are your buccaneers?"

To which the little boy replied: "Under my buccan hat."

Prof.: "Mr. Schlooper, what do you know about French syntax?"

C.E.: "Gosh, I didn't know they had to pay for their fun."

One of today's greatest labor saving devices is tomorrow.

First Coed: "Why do men have hairs on their chests?"

Second Coed: "Well, they can't have everything."

Don't be afraid to use your brain, it's the little things that count."

"Hey, Murphy, what are you putting in your vest pocket?"

"A stick of dynamite. Everytime O'Leery sees me, he slaps me on the chest and breaks my cigars. The next time he tries it, he'll blow his damn hand off."

Truck driver stopped beside stalled Volkswagon on highway: "What's the matter, buddy -- need a new flint?"

Some people have no respect for age unless its bottled.

And then there was the tugboat that committed suicide when it found out that its mother was a tramp and its father was a ferry.

"What do you get when you cross a grape and an elephant?" "(grape) (elephant) sinO."

One stork to another: "Am I ever embrassed. How was I to know they weren't married?"

Critic: "It strikes me as being an impressive statue, yet isn't that rather an odd posture for a general to assume?"

Sculptor: "It isn't my fault, I had the job half done when the committee decided they couldn't afford a horse."

Two's company, three's a result.

Hit by a speeding midget sports car as she was strolling across a country road, a little hen got up, smoothed down her feathers and muttered: "Lively little cuss, but he didn't get anywhere."

Visiting a critically ill lawyer in the hospital, a friend found him propped up in bed, frantically leafing through a Bible.

"What are you doing?" the friend asked. Replied the lawyer, "Looking for loopholes!"

When the Creator was making the world, he called Man aside and bestowed upon him 20 years of normal sex life. Man was horrified. "Only 20 years?" But the Creator wouldn't budge.

He called the Monkey and gave him 20 years. "But I don't need 20 years," the Monkey protested. "Ten is plenty."

Man spoke up, "Can I have the other ten years?" The Monkey graciously agreed to this.

Then the Creator gave the Lion 20 years. The Lion, too, only needed 10 years. Again Man asked. "Can I have the other ten years?" The Lion agreeded.

Then came the Donkey. He was given 20 years, but 10 years was enough for him, too. Man again asked for the spare 10 years and got them.

This explains why Man has 20 years of normal sex life, 10 years of monkeying around, 10 years of lion about it, and 10 years of making an ass out of himself.

A whole herd of buffaloes was stampeding across the plains. Suddenly the lead buffalo hesitated and was quickly overtaken. He was knocked down and trampled on by the rest of the herd. The last buffalo was kind-hearted and stopped to console his fallen friend. He solicitously asked, "But why did you stop so suddenly?"

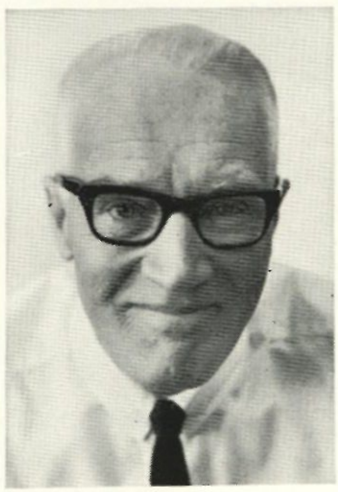
"Well," replied the lead buffalo, "I thought I heard a discouraging word."

And then there was the hippy who reported that in a recent test, his group had 23% less chromosome damage.

RANDY LORANCE

Top grades as a kid, to get into college. Then the matter of survival through four or five years of engineering study. Soon, with luck, the battle will be won. A full-fledged engineer has been created,

ready to serve



the boss!

AND HE HAD BETTER BE READY FOR YOU. Bosses who think like caricatures lack the capacity to run important operations that call for the brightest operating talent that a stepped-up educational system turns out. The new talent that may or may not choose to make itself available takes a careful look at the carrots being offered.

Once we decide we like that bright new talent—and we decided that quite a while ago—it becomes necessary to put up with their demands. Aside from the expected attractive package of salary, benefits, and advancement plan, the ones we have chosen to chase often demand in addition an opportunity to try their newer and subtler ways of thought against old problems. As it happens, we need this type badly, because we have plenty of stubborn old problems, plenty of financial incentive to crack them, and a very stable platform for launching new ventures that take a little while to pay off. (The latter must not be underrated as an attraction.)

Sweeping generalizations are no more reliable for the Class of 1968 than for the boys of '38. Not all '68's finest engineering minds disclaim knowledge of how to handle a screwdriver nor shun empiricism. We offer excellent carrots, along with money, to engineers with a knack for making things work even when they can't explain why.

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